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Mark Scheme (Results)

Summer 2023

**Pearson Edexcel GCSE**  
**In Chemistry (1CH0)**  
**Paper 1F**

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## General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Mark schemes have been developed so that the rubrics of each mark scheme reflects the characteristics of the skills within the AO being targeted and the requirements of the command word. So for example the command word 'Explain' requires an identification of a point and then reasoning/justification of the point.

Explain questions can be asked across all AOs. The distinction comes whether the identification is via a judgment made to reach a conclusion, or, making a point through application of knowledge to reason/justify the point made through application of understanding. It is the combination and linkage of the marking points that is needed to gain full marks.

When marking questions with a 'describe' or 'explain' command word, the detailed marking guidance below should be consulted to ensure consistency of marking.

Assessment Objective		Command Word	
Strand	Element	Describe	Explain
AO1		An answer that combines the marking points to provide a logical description	An explanation that links identification of a point with reasoning/justification(s) as required
AO2		An answer that combines the marking points to provide a logical description, showing application of knowledge and understanding	An explanation that links identification of a point (by applying knowledge) with reasoning/justification (application of understanding)
AO3	1a and 1b	An answer that combines points of interpretation/evaluation to provide a logical description	
AO3	2a and 2b		An explanation that combines identification via a judgment to reach a conclusion via justification/reasoning
AO3	3a	An answer that combines the marking points to provide a logical description of the plan/method/experiment	
AO3	3b		An explanation that combines identifying an improvement of the experimental procedure with a linked justification/reasoning

Question number	Answer	Mark
1(a)(i)	D Z is the only correct answer.  A, B and C are incorrect because they have more than one spot	AO1-1 (1)

Question number	Answer	Mark
1(a)(ii)	C Y is the only correct answer.  A, B and D are incorrect because those inks have fewer spots	AO3-1 (1)

Question number	Answer	Additional guidance	Mark
1(a)(iii) Group B	0.39 scores 2 marks with or without working  $\frac{3.60}{9.20} = 0.39(1304\dots) \text{ (1)}$ $= 0.39 \text{ (1) (rounded to 2dp)}$	fraction $\frac{9}{23}$ scores 1 mark  1 mark for correct substitution and evaluation $\frac{3.60}{9.20} = 0.4$ scores 1 only for correct evaluation to 1dp Note: 0.4 alone without working scores 0  1 mark for correct rounding (has to use the numbers 3.60 and 9.20 in the calculation)  $\frac{9.20}{3.60} = 2.56$ scores 1 (for 2dp)  Note: by default $3.60 \times 9.20 = 33.12$ has an answer to 2dp, so 2 <sup>nd</sup> mark is given	AO2-1 (2)

Question number	Answer	Additional guidance	Mark
1 (b) (i)	evaporation / evaporating	allow boiling / vaporisation do not allow boiling <u>point</u> / bpt	AO1-1 (1)

Question number	Answer	Additional guidance	Mark
1 (b) (ii)	56 (°C)		AO3-1 (1)

Question number	Answer	Additional guidance	Mark
1 (b) (iii)	6 (minutes)		AO3-1 (1)

Question number	Answer	Additional guidance	Mark
1 (b) (iv)	answers between 49 and 51 score 1 mark with or without working.  75 - 25 = 50 (1)	allow readings between 74 and 76	AO3-1 (1)

Total for Question 1 = 8 marks

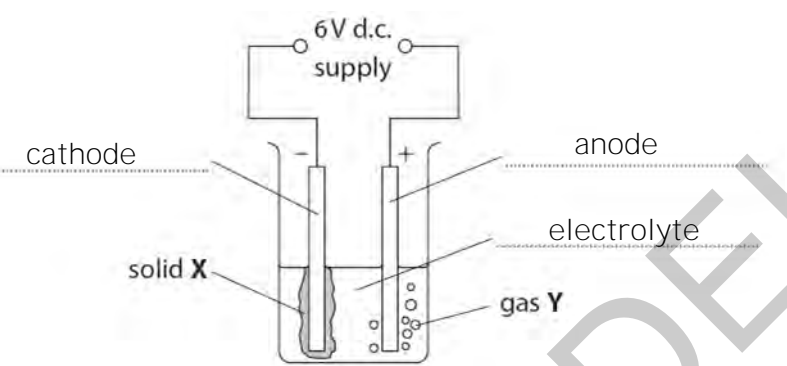
Question number	Answer	Additional guidance	Mark
2(a) Group A	the higher the {(number of) carats / purity}, the greater the percentage of gold (OWTTE)		AO3-1 (1)

Question number	Answer	Additional guidance	Mark
2(b) Group A	<p>an explanation linking</p> <ul style="list-style-type: none"> <li>{ atoms are all the same size in pure gold / atoms are different sizes in alloy} (1)</li> <li>(atoms in) { layers / rows} in pure gold / ORA (1)</li> <li>(layers / rows) can slide easily in pure gold / ORA (1)</li> </ul>	<p><b>allow 'they' to mean gold alloys</b></p> <p>allow ions / particles</p> <p>allow regular arrangement</p> <p><b>allow slip / move for 'slide'</b></p> <p>allow atoms roll</p>	AO2-1 (3)

Question number	Answer	Additional guidance	Mark
2(c) Group A	<p>an explanation linking a property with a suitable reason</p> <ul style="list-style-type: none"> <li>(gold is) unreactive (1)</li> <li>so will not react with skin / will not corrode (1)</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>malleable (1)</li> <li>so can be shaped (1)</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>shiny (1)</li> <li>looks attractive owtte (1)</li> </ul>	<p>mark independently</p> <p>ignore references to cost and irrelevant properties</p> <p>allow will not react with oxygen / water / other household substances</p> <p>allow will not tarnish</p> <p>ignore rust</p> <p>ignore corrosive</p> <p>allow ductile in place of malleable</p> <p>ignore references to colour</p>	AO2-1 (2)

Total for Question 2 = 6 marks

Question number	Answer	Mark
3(a)	B the decomposition of ionic compounds is the only correct answer A, C and D are incorrect statements	AO1-1 (1)

Question number	Answer	Additional guidance	Mark
3(b)(i)		<p>All 3 correct scores 2 marks</p> <p>1 or 2 correct scores 1 mark</p> <p>allow copper chloride solution to replace electrolyte</p>	AO1-2 (2)

Question number	Answer	Additional guidance	Mark						
3(b)(ii)	<table border="0"> <thead> <tr> <th>product</th> <th>name</th> </tr> </thead> <tbody> <tr> <td>solid X</td> <td> <input type="checkbox"/> carbon  <input checked="" type="checkbox"/> chlorine  <input checked="" type="checkbox"/> copper  <input type="checkbox"/> hydrogen </td> </tr> <tr> <td>gas Y</td> <td> <input type="checkbox"/> carbon  <input type="checkbox"/> chlorine  <input type="checkbox"/> copper  <input checked="" type="checkbox"/> hydrogen </td> </tr> </tbody> </table>	product	name	solid X	<input type="checkbox"/> carbon <input checked="" type="checkbox"/> chlorine <input checked="" type="checkbox"/> copper <input type="checkbox"/> hydrogen	gas Y	<input type="checkbox"/> carbon <input type="checkbox"/> chlorine <input type="checkbox"/> copper <input checked="" type="checkbox"/> hydrogen	<p>one mark for each line</p> <p>do not award mark if more than one line is drawn from each box on the left</p>	AO1-2 (2)
product	name								
solid X	<input type="checkbox"/> carbon <input checked="" type="checkbox"/> chlorine <input checked="" type="checkbox"/> copper <input type="checkbox"/> hydrogen								
gas Y	<input type="checkbox"/> carbon <input type="checkbox"/> chlorine <input type="checkbox"/> copper <input checked="" type="checkbox"/> hydrogen								

Question number	Answer	Additional guidance	Mark
3(b)(iii) Group B	An explanation linking the following <ul style="list-style-type: none"> <li>• no current will flow / solid ionic compounds do not conduct electricity (1)</li> <li>• (because) ions <b>can't move</b> / ions in a lattice (1)</li> </ul>	Allow reverse arguments  allow no electricity flows <b>do not accept 'nothing happens'</b>  ignore charged particles <b>reject electrons/atoms/molecules can't move</b>  if no other mark awarded allow 1 mark for ' <b>copper chloride isn't dissolved</b> ' / ' <b>it will only work if ions are in solution</b> '	AO1-1 (2)

Total for Question 3 = 7 marks

Question number	Answer	Mark
4(a)(i)	D oxygen is the only correct answer  A, B and C are incorrect because they are not required for corrosion to occur.	AO1-1 (1)

Question number	Answer	Mark
4(a)(ii)	C the iron has been oxidised is the only correct answer  A, B and D are incorrect because in corrosion the metal is oxidised.	AO1-1 (1)

Question number	Answer	Additional guidance	Mark
4(b) Group B	162.5 with or without working scores 2 marks  56 + 35.5 + 35.5 + 35.5 (1)  = 162.5 (1)	allow  91.5 scores 1 mark	AO1-1 (2)

Question number	Answer	Additional guidance	Mark
4(c)(i)	carbon	allow C, c	AO3-1 (1)

Question number	Answer	Additional guidance	Mark
4(c)(ii)	chromium	Allow Cr, cr, CR, cR	AO3-1 (1)

Question number	Answer	Additional guidance	Mark
4(c)(iii) Group A	<p>an explanation linking</p> <ul style="list-style-type: none"> <li>• paint / grease / coat with plastic (1)</li> <li>• prevents {oxygen / water} reaching the iron (1)</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• galvanising (1)</li> <li>• prevents {oxygen / water} reaching the iron / sacrificial protection / zinc is more reactive than iron (1)</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• sacrificial protection (1)</li> <li>• the more reactive metal corrodes instead of iron (1)</li> </ul>	<p>allow waterproof as an alternative for preventing water reaching the iron</p> <p>allow</p> <ul style="list-style-type: none"> <li>• electroplate / plate with another metal (1)</li> <li>• prevents {oxygen / water} reaching the iron (1)</li> </ul>	AO1-1 (2)

Question number	Answer	Additional guidance	Mark
4(d) Group A	<p>a plan to include</p> <ul style="list-style-type: none"> <li>• put nails in boiling tubes with water (1)</li> <li>• leave for some time (1)</li> <li>• observe which nail forms rust {first / most} (1)</li> </ul>	<p>if answers introduce further variables to one tube then MP1 cannot score.</p> <p>allow any idea of time passing – even if too short for corrosion</p> <p>allow colour change for rust</p>	AO3-3 (3)

Total for Question 4 = 11 marks

Question number	Answer	Mark
5(a)(i)	ON LEFT: potassium chloride AND ON RIGHT: potassium nitrate	AO2-1 (1)

Question number	Answer	Mark
5(a)(ii)	D is the correct answer  A, B and C are the hazard symbols for corrosive, flammable and harmful	AO2-1 (1)

Question number	Answer	Additional guidance	Mark
5(b)(i)	measuring cylinder	allow burette / pipette / syringe	AO3-3 (1)

Question number	Answer	Additional guidance	Mark
5(b)(ii) Group A	$2.4 + 2.4 + 2.7 = 7.5$ (1)  $\frac{7.5}{3} = 2.5$ (1)	2.5 with or without working scores 2 marks  allow ECF for an incorrect evaluation divided by 3 allow $2.4 + 2.4 = 4.8$ , $4.8/2 = 2.4$ (1)  $2.4 + 2.4 + 2.7 \div 3 = 5.7$ (1) $2.4 + 2.7 + 2.4 \div 3 = 5.9$ (1)	AO2-2 (2)

Question number	Answer	Additional guidance	Mark
5(b)(iii) Group A	<p>a description to include the following points</p> <p>First mark Filter (the mixture) (1)</p> <p>Second and third marks A description including two of the following</p> <p>Calcium carbonate / the solid / the residue / precipitate is left on (filter) paper / on the funnel (1)</p> <p>Wash / rinse (the solid/residue/calcium carbonate with distilled water) (1)</p> <p>any method of drying (1)</p>	<p>maximum 1 mark if heat or evaporate or crystallisation method used on mixture or filtrate</p> <p>description or diagram of filtering or diagram of filtering ie (filter) funnel and filter paper</p> <p>do not allow sieving/sifting/draining/decanting do not allow separating funnel</p> <p>pour water over/through solid (in filter paper) clean solid with water do not allow this mark if washing is done after drying</p> <p>eg in an oven / on a windowsill / on a radiator / with filter paper warm it heat it evaporate the water <b>allow 'leave to dry'</b> <b>do not allow just 'dry it (out/off)'</b></p>	AO2-2 (3)

Question number	Answer	Additional guidance	Mark
5(b) (iv) Group A	any one of the following <ul style="list-style-type: none"> <li>• volume / concentration of { potassium carbonate / carbonate / potassium solution}</li> <li>• concentration of (calcium) nitrate</li> <li>• time allowed for settling</li> </ul>	allow amount of (potassium) carbonate <b>ignore 'volume' alone</b>  ignore { amount / volume} of calcium nitrate  ignore time (alone) allow temperature allow diameter of test tube	AO3-3b (1)

Total for Question 5 = 9 marks

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Question number	Answer	Additional guidance	Mark
6(a) (i) Group B	any one of the following <ul style="list-style-type: none"> <li>shiny</li> <li>high {melting / boiling} point</li> <li>good conductor of {electricity / heat}</li> <li>malleable / ductile</li> <li>grey coloured</li> </ul>	allow easily shaped / can be drawn into wires allow silver coloured ignore density / sonorous / solid ignore strength / strong / hard	AO1-1 (1)

Question number	Answer	Mark
6(a) (ii)	D strontium is the only correct answer  A, B and C are incorrect because they are all in a different group to magnesium.	AO1-1 (1)

Question number	Answer	Mark
6(b) (i)	2.8.2	AO1-1 (1)

Question number	Answer	Additional guidance	Mark
6(b) (ii) Group B	an explanation linking any two of <ul style="list-style-type: none"> <li>(chlorine has) 3 shells / 3 numbers in electronic configuration (1)</li> <li>(so) (chlorine is in) period 3 (1)</li> <li>number of shells is the period number (1)</li> </ul>	reject ' <b>3 outer shells</b> ' allow electron configuration diagram for 1 <sup>st</sup> mark	AO1-1 (2)

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Question number	Answer	Additional guidance	Mark
6(c) Group B	<p>MP1 for dividing by atomic mass</p> $\begin{array}{l} \text{Mg} \quad : \quad \text{Cl} \\ \hline 1.20 \quad : \quad 3.55 \quad (1) \\ 24.0 \quad \quad 35.5 \end{array}$ <p>MP2 for deriving ratio from MP1</p> $0.05 \quad : \quad 0.1$ <p>OR</p> $1 \quad : \quad 2 \quad (1)$ <p>MP3 for formula using ratio in MP2</p> $\text{MgCl}_2 \quad (1)$	<p><math>\text{MgCl}_2</math> without working scores 0</p> <p>Allow ECF</p> <p>allow</p> $\text{Mg} \frac{24.0}{1.20} : \text{Cl} \frac{35.5}{3.55} \quad (0)$ $20 \quad : \quad 10$ <p>OR</p> $2 \quad : \quad 1 \quad (1)$ <p>empirical formula <math>\text{Mg}_2\text{Cl}</math> (1)</p> <p>reject superscript numbers for MP3 only</p>	AO2-1 (3)
6(d) Group B	<p>A description to include</p> <p>ionic (max 2 marks)</p> <ul style="list-style-type: none"> <li>(electrostatic) force between (oppositely charged) ions / between anions and cations (2)</li> </ul> <p>covalent (max 2 marks)</p> <ul style="list-style-type: none"> <li>atoms share a pair electrons (2)</li> </ul>	<p>other creditable responses (max 1 mark) including any one from:</p> <ul style="list-style-type: none"> <li>{ ions / cations / anions } are charged particles</li> <li>ionic bonds between metals and non-metals</li> <li>electrons transferred (from metal to non-metal)</li> <li>metals lose electrons / non-metals gain electrons</li> </ul> <p>reject electrons transferred from non-metal to metals</p> <p>other creditable responses (max 1 mark) including any one from:</p> <ul style="list-style-type: none"> <li>covalent bonds are formed when electrons are shared</li> <li>covalent bonds form molecules</li> <li>covalent bonds between non-metals</li> </ul>	AO1-1 (4)

Total for Question 6 = 12 marks

Question number	Answer	Additional guidance	Mark
7(a)(i)	phosphorus / P	reject phosphorus oxide, P <sub>2</sub> O <sub>5</sub>	AO3-2 (1)

Question number	Answer	Additional guidance	Mark
7(a)(ii)	C nitric acid is the only correct answer  A is incorrect because ethanoic acid makes ethanoate salts. B is incorrect because hydrochloric acid makes chloride salts. D is incorrect because sulfuric acid makes sulfate salts		AO1-1 (1)

Question number	Answer	Additional guidance	Mark
7(a)(iii) Group B	to promote plant growth / increase (crop) yield / provide nutrients to plants	allow plants / crops grow faster <b>ignore 'food'</b> reject references to killing pests / weeds	AO1-1 (1)

Question number	Answer	Additional guidance	Mark
7(b)(i) Group A	LHS: ammonia + sulfuric acid → (1)  RHS: → ammonium sulfate (1)	allow words in either order reject additional reagents and products  do not allow ammonium on LHS or ammonia on RHS	AO2-1 (2)

Question number	Answer	Additional guidance	Mark
7(b)(ii) Group A	products needed on a larger scale than can be obtained in titration / owtte	ignore references to cost allow batch process allow yield in terms of quantity produced allow takes longer to produce	AO1-2 (1)

Question number	Indicative content	Mark
*7(c) Group A	<p><b>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic mark scheme.</b></p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p>AO1 (6 marks)</p> <ul style="list-style-type: none"> <li>• pipette to measure out the sulfuric acid</li> <li>• <b>into a suitable container, e.g. conical flask</b></li> <li>• <b>add few drops of (suitable) indicator</b></li> <li>• <b>put flask on a white tile</b></li> <li>• <b>fill burette with ammonia solution</b></li> <li>• <b>read level of liquid in burette</b></li> <li>• <b>add ammonia solution from the burette</b></li> <li>• <b>swirl flask gently / mix</b></li> <li>• <b>add drop-wise near end-point</b></li> <li>• <b>until indicator just changes colour</b></li> <li>• <b>read level on burette</b></li> <li>• <b>repeat experiment until concordant results</b></li> </ul> <p>CRYSTALLISATION</p> <ul style="list-style-type: none"> <li>• <b>mix the same volumes of sulfuric acid and ammonia solution (determined from the titration experiment)</b></li> <li>• <b>but leaving out the indicator</b></li> <li>• <b>pour solution into an evaporating dish</b></li> <li>• <b>heat the solution to point of crystallisation</b></li> <li>• <b>leave to cool</b></li> <li>• <b>filter off / decant crystals</b></li> <li>• <b>leave to dry / pat dry with filter paper</b></li> </ul>	AO1-2 (6)

Level	Mark	Descriptor
	0	<ul style="list-style-type: none"><li>• No awardable content.</li></ul>
Level 1	1–2	<ul style="list-style-type: none"><li>• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas, enquiry, techniques and procedures lacks detail.</li><li>• Presents a description which is not logically ordered and with significant gaps.</li></ul>
Level 2	3–4	<ul style="list-style-type: none"><li>• Demonstrates chemical understanding which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed.</li><li>• Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing.</li></ul>
Level 3	5–6	<ul style="list-style-type: none"><li>• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed.</li><li>• Presents a description that has a well developed structure which is clear, coherent and logical.</li></ul>

Level	Mark	Descriptor	Additional Guidance
	0	No rewardable material.	Read whole answer and ignore all incorrect material/ discard any contradictory material then:
Level 1	1-2	<u>Additional Guidance</u> Gives a description including limited details of the titration OR the crystallisation.	<u>Possible candidate response</u> <ul style="list-style-type: none"> <li>using a pipette, measure out some ammonia solution and add acid from the burette (ORA for chemicals) (2)</li> <li>add indicator to conical flask (1)</li> <li>heat the neutral solution (1) until crystals start to form (1)</li> </ul>
Level 2	3-4	<u>Additional Guidance</u> Gives a description of carrying out the titration with some detail.  OR  Gives a description of carrying out the crystallisation with some detail.  OR  Gives a description including limited detail of the titration AND the crystallisation	<u>Possible candidate response</u> <ul style="list-style-type: none"> <li>use a pipette to measure out the acid and add to the conical flask along with a few drops of indicator. Put the flask onto a white tile. Add ammonia from the burette until the indicator changes colour, swirling the flask. (4)</li> <li>heat the ammonium sulfate solution using a Bunsen burner until crystals start to form, then turn off the Bunsen and allow the mixture to cool. Filter off the crystals and pat them dry with some filter paper. (4)</li> <li>use a pipette to measure out the ammonia solution. Add some indicator and add acid from the burette. Leave the ammonium sulfate solution on the windowsill to crystallise. (3)</li> </ul>
Level 3	5-6	<u>Additional Guidance</u> Gives a detailed description of the titration and some detail about crystallisation  OR  Gives a detailed description of the crystallisation and some detail about carrying out a titration	<u>Possible candidate response</u> <ul style="list-style-type: none"> <li>use a pipette to measure out the acid and add to conical flask along with a few drops of indicator. Add the ammonia solution from the burette until the solution is neutral. Repeat the procedure but add the acid drop by drop near the neutralisation point. Then repeat the procedure with the known volumes but without indicator. This solution should then be heated until crystals start to form. (6)</li> <li>measure out the ammonia solution using a pipette and add acid until it has been neutralised. Pour the solution into an evaporating basin and heat gently until crystals have started to form. Allow the solution to cool and crystallise by leaving it in a warm place such as on a windowsill. (6)</li> </ul>

Total for Question 7 = 12 marks

Question number	Answer	Additional guidance	Mark
8(a) Group A	stir/ swirl/ shake (the beaker)	allow mix, warm/ heat ignore wait (until reaction over/ until powder disappears)	AO1-2 (1)

Question number	Answer	Additional guidance	Mark
8(b) Group B	in either order:  calcium chloride (1)  water (1)	allow phonetic spellings but reject calcium chlorine  allow CaCl <sub>2</sub> but formula must be correct for the mark <b>ignore 'solution'/ any state symbols</b> allow H <sub>2</sub> O but formula must be correct for the mark if three products given, allow (1) only if both correct products are given. four or more products scores (0)	AO2-1 (2)

Question number	Answer	Mark
8(c)	C s aq is the only correct answer  A, B and D are not correct because the calcium hydroxide is a solid and the acid is an aqueous solution.	AO2-1 (1)

Question number	Answer	Additional guidance	Mark
8(d) (i)	1	allow 0.9 or 1.1	AO3-2 (1)

Question number	Answer	Mark
8(d) (ii)	0.74 (g)	AO3-2 (1)

Question number	Answer	Additional guidance	Mark
8(d)(iii) Group B	<p>An explanation linking:</p> <p>START</p> <ul style="list-style-type: none"> <li>solution is acidic / acids have low pH / high {concentration/ amount} of H<sup>+</sup> ions/ excess H<sup>+</sup> ions (1)</li> </ul> <p>REACTION</p> <ul style="list-style-type: none"> <li>neutralisation/ H<sup>+</sup> + OH<sup>-</sup> → H<sub>2</sub>O/ {the hydroxide/ alkali} <u>reacts</u> with the {acid/ H<sup>+</sup>} (1)</li> </ul> <p>END</p> <ul style="list-style-type: none"> <li>{amount/ concentration} of H<sup>+</sup> ions has reduced/ {amount/ concentration} of OH<sup>-</sup> ions has increased / excess OH<sup>-</sup> ions/ (excess of) hydroxide ions have pH &gt; 7 (1)</li> </ul>	<p>allow for low pH: pH less than 7 / pH 1-6 / pH =1 ignore there is no alkali ignore <b>references to 'strong' or weak'</b></p> <p>allow acid → neutral → alkali (2)</p> <p>allow calcium hydroxide is {an alkali/a base} ignore description of pattern – as calcium hydroxide added pH increases (0) <b>ignore 'becomes alkaline'/ is alkaline/ is less acidic</b></p>	AO2-1 (3)

Question number	Answer	Additional guidance	Mark
8(e) Group B	pH meter / pH probe	<p>allow universal indicator / pH paper ignore pH scale do not allow any other named indicator, or <b>'indicator' alone.</b></p>	AO1-2 (1)

Question number	Answer	Additional guidance	Mark
8(f) Group A	goggles / gloves / eye protection	<p>allow safety glasses ignore wearing lab coats ignore references to general lab safety, e.g. tie hair back, stand up</p>	AO1-2 (1)

Total for Question 8 = 11 marks

Question number	Answer	Mark
9(a)	A calcium is the only correct answer  B, C and D are incorrect because copper, silver and gold do not react with cold water	AO1-1 (1)

Question number	Answer	Additional guidance	Mark
9(b) (i) Group B	<p>MAGNESIUM many bubbles / bubbles produced quickly / bubbles vigorously OR test tube feels hot / warm / warmer than with zinc (1)</p> <p>IRON few bubbles / bubbles produced slowly / some bubbles OR test tube feels <u>very</u> slightly warm (1)</p>	<p>Mark answer lines first, if blank or only contain statements that can be ignored, then look at the table. Ignore hydrogen / gas / reactivity of metal reject incorrect additional observations for each metal</p> <p><b>allow 'magnesium disappears/ dissolves'</b> ignore steady bubbling / slightly warm</p> <p>ignore steady bubbling / no bubbling</p> <p>allow does not feel warm ignore test tube feels slightly warm</p>	AO3-2 (2)

Question number	Answer	Additional guidance	Mark
9(b) (ii) Group B	a description to include the following points <ul style="list-style-type: none"> <li>• apply lighted splint (to the gas) (1)</li> <li>• (squeaky) pop (1)</li> </ul>	allow apply flame / ignite <b>ignore 'squeaky pop test'</b> reject glowing splint  MP2 depends on MP1	AO1-2 (2)

Question number	Answer	Additional guidance	Mark
9(b) (iii)	$\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$ H <sub>2</sub> (1)  2 (1)	reject H2, H <sup>2</sup> , 2H, 2h, h <sub>2</sub> , h <sup>2</sup>	AO2-1 (2)

Question number	Indicative content	Mark
*9(c) Group B	<p><b>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic mark scheme.</b></p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p><b>ALUMINIUM</b></p> <ul style="list-style-type: none"> <li>• extracted by electrolysis</li> <li>• aluminium is more reactive than carbon / ORA</li> <li>• aluminium compound is reduced / redox reaction</li> <li>• as heating with carbon will not work</li> <li>• a more powerful method / more energy is needed</li> <li>• electrolysis is expensive</li> </ul> <p><b>IRON</b></p> <ul style="list-style-type: none"> <li>• heating with carbon</li> <li>• iron is less reactive than carbon</li> <li>• iron compound is reduced / redox reaction</li> <li>• method cheaper than electrolysis</li> </ul> <p><b>SILVER</b></p> <ul style="list-style-type: none"> <li>• found uncombined / native state / often just mined</li> <li>• low reactivity</li> <li>• so reduction not needed</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>• silver is less reactive than carbon</li> <li>• heating with carbon</li> <li>• silver compound is reduced / redox reaction</li> <li>• method cheaper than electrolysis</li> </ul> <p><b>GOLD</b></p> <ul style="list-style-type: none"> <li>• found uncombined / native state / often just mined</li> <li>• least reactive / low reactivity</li> <li>• so reduction not needed</li> </ul>	AO2-1 (6)

Level	Mark	Descriptor
	0	<ul style="list-style-type: none"> <li>• No awardable content.</li> </ul>
Level 1	1–2	<ul style="list-style-type: none"> <li>• The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question.</li> <li>• Lines of reasoning are unsupported or unclear.</li> </ul>
Level 2	3–4	<ul style="list-style-type: none"> <li>• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question.</li> <li>• Lines of reasoning mostly supported through the application of relevant evidence.</li> </ul>
Level 3	5–6	<ul style="list-style-type: none"> <li>• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question.</li> <li>• Lines of reasoning are supported by sustained application of relevant evidence.</li> </ul>

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Level	Mark	Descriptor	Additional Guidance
	0	No rewardable material.	Read whole answer and ignore all incorrect material and any references to other metals / discard any contradictory material then:
Level 1	1–2	<p><u>Additional Guidance</u> Correctly identifies method to obtain 1 named metal</p> <p>Correctly identifies method to obtain 2 named metals</p> <p>Correctly identified method to obtain 1 named metal with a part explanation</p>	<p><u>Possible candidate response</u> (all examples, not a definitive list) Aluminium is obtained using electrolysis (1)</p> <p>Gold and silver are obtained as the pure metal (2)</p> <p>Aluminium is obtained using electrolysis because it is very reactive (2)</p>
Level 2	3–4	<p><u>Additional Guidance</u> Correctly identifies methods for all four metals (with no explanation)</p> <p>Correctly identified method to extract at least 1 named metal with a full explanation</p> <p>Correctly identifies method to extract at least 2 named metals with part explanations for one (3) or two (4).</p>	<p><u>Possible candidate response</u> Aluminium extracted using electrolysis, iron obtained by heating with carbon, gold and silver are found as pure metals (3)</p> <p>Iron is extracted by heating (the ore) with carbon as iron is less reactive than carbon and is cheaper than electrolysis (3)</p> <p>Silver and gold are obtained as the {pure/unreacted} metals as they are {unreactive/low in reactivity} (3)</p>
Level 3	5–6	<p><u>Additional Guidance</u> Correctly identifies method to extract at least 2 metals with full explanations</p> <p>Correctly identifies method to extract at least 3 metals with a full explanation for one metal</p>	<p><u>Possible candidate response</u> Iron is extracted by heating (the ore) with carbon as iron is less reactive than carbon and is cheaper than electrolysis, and aluminium is obtained using electrolysis because it is very reactive and heating with carbon will not work</p> <p>Aluminium is extracted by electrolysis, iron by heating (the ore) with carbon and silver is found as the unreacted metal as it is very unreactive and reduction is not needed</p>

Total for Question 9 = 13 marks

Question number	Answer	Additional guidance	Mark
10(a) Group A	<p>final answer of 34 with or without working scores 4</p> <p>total mass = 191 (1)</p> $\frac{64}{191} = 0.33507 \text{ (1)}$ <p>x 100 = 33.507 (1)</p> <p>= 34 (1)</p>	<p>allow ecf at MPs 2-4</p> <p>MP2 must be for 64/ total mass from MP1 note: 63.5/191 is not correct</p> <p>MP3 must be for multiplying fraction from MP2 that has been produced using question data x 100</p> <p>MP4 for rounding correctly number produced using question data to 2s.f. and must be &lt;100%</p> <p>33.5/ 33.51 scores 3 0.33 scores 2 0.34 scores 3 33 scores 3 64/382 x 100 = 17 scores 3 191/64 x 100 = 298 scores 2 64/127(.5) x 100 = 50 scores 3 191/191 x 100 = 100 scores 1</p>	AO2-1 (4)

Question number	Answer	Mark
10(b)	<p>D 1910 orange is the only correct answer.</p> <p>A, B and C are incorrect because vanadium pentoxide is a transition metal compound which is coloured and has a high melting point.</p>	AO2-1 (1)

Question number	Answer	Additional guidance	Mark
10(c) (i) Group A	<p>final answer of 490 with or without working scores 2</p> $\frac{400}{80} = 5 \text{ (1)}$ $5 \times 98 = 490 \text{ (1)}$ <p>OR</p> $\frac{98}{80} = 1.225 \text{ (1)}$ $1.225 \times 400 = 490 \text{ (1)}$	<p>80/ 400 x 98 = 19.6 scores 1 allow ecf for MP2 only if MP1 uses 80 and 98</p> <p>80/98 x 400 = 326.5 scores 1 allow ecf for MP2 only if MP1 uses 80 and 98</p> <p>allow 490000 kg <u>only if unit given</u> allow 490000000 g <u>only if unit given</u></p>	AO2-1 (2)

Question number	Answer	Additional guidance	Mark
10(c) (ii) Group B	<p>final answer of 96% with or without working scores 2</p> $\frac{672}{700} = 0.96 \text{ (1)}$ $\times 100 = 96 \text{ (1)}$	<p>allow 24/25</p> <p>no ecf for MP2 4 scores 1</p> <p>104 scores 1 mark</p>	AO2-1 (2)

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Question number	Answer	Additional guidance	Mark
10(c) (iii) Group B	<p>Any two of the following</p> <ul style="list-style-type: none"> <li>• incomplete reaction</li> <li>• loss {of substance/reactant/product} (during practical)/ practical losses</li> <li>• unwanted reactions / side-reactions</li> </ul>	<p>ignore impure reactants/ contaminants/ reaction conditions/ human error/ measurement errors/ reversible reaction</p> <p>allow reaction incomplete/ reactant left over/ not all reactants used</p> <p>allow reasonable examples e.g. left in apparatus/ in transfers/ escape to air/ not in a closed system/ lost to surroundings</p> <p>ignore incompetence e.g. spillages</p> <p>allow reasonable example e.g product reacts with air</p> <p>ignore waste products/ byproducts</p>	AO1-1 (2)

Total for Question 10 = 11 marks